

6. Infiltration testing – site-specific geotechnical test results to reflect different project types and different levels of infiltration



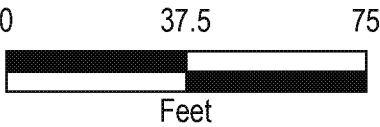
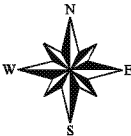
City of Lancaster
Green Infrastructure Plan
Demonstration Project

Site 115: West James Street

PROPOSED CONCEPT PLAN

Legend

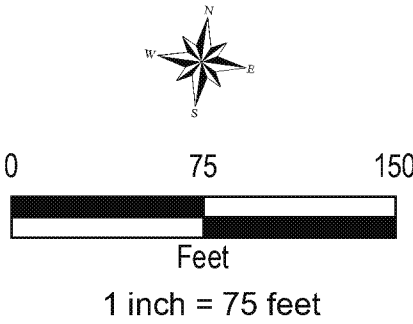
- Hydrants
- Storm Inlets
- Manholes
- Gravity Sewer Lines
 - 4" - 15" diam.
 - 15" - 30" diam.
 - 30" - 60" diam.
 - 60" - 120" diam.
- Parcel Boundary
- Drainage Areas
- GI Concepts
 - Bioretention
 - Infiltration Trench
 - Existing Tree Canopy



Site 134:
W. Liberty Street

CONCEPT PLAN

- Legend**
- Inlet
 - Inlets (IMS Surveyed)
 - Hydrants
 - Manholes
 - ADA Ramps
 - Gravity Sewer Lines
 - 4" - 15" diam.
 - 15" - 30" diam.
 - 30" - 60" diam.
 - 60" - 120" diam.
 - Parcel Boundary
 - Drainage Areas
 - Proposed Bioretention
 - Proposed Infiltration Trench
 - Proposed Porous Pavers
 - Existing Tree Canopy



Site 162:
Walnut Street, from
N Prince St to N Christian St

CONCEPT PLAN

Legend

- Inlet
- Inlets (IMS Surveyed)
- Hydrants
- Manholes
- ADA Ramps
- Gravity Sewer Lines
 - 4" - 15" diam.
 - 15" - 30" diam.
 - 30" - 60" diam.
 - 60" - 120" diam.
- Parcel Boundary
- Drainage Areas
- Proposed Bioretention
- Proposed Infiltration trench
- Proposed Tree Trench
- Existing Tree Canopy



0 35 70



Feet

1 inch = 70 feet



Site 165:
Hershey Ave, from
Wabank St to Hager St
CONCEPT PLAN

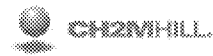
Legend

- Inlet
- Inlets (IMS Surveyed)
- Hydrants
- Manholes
- ADA Ramps
- Gravity Sewer Lines
 - 4" - 15" diam.
 - 15" - 30" diam.
 - 30" - 60" diam.
 - 60" - 120" diam.
- Parcel Boundary
- Drainage Areas
- Proposed Bioretention
- Existing Tree Canopy



0 25 50
Feet

1 inch = 50 feet



Map prepared Nov 2014



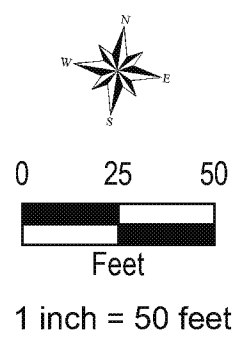


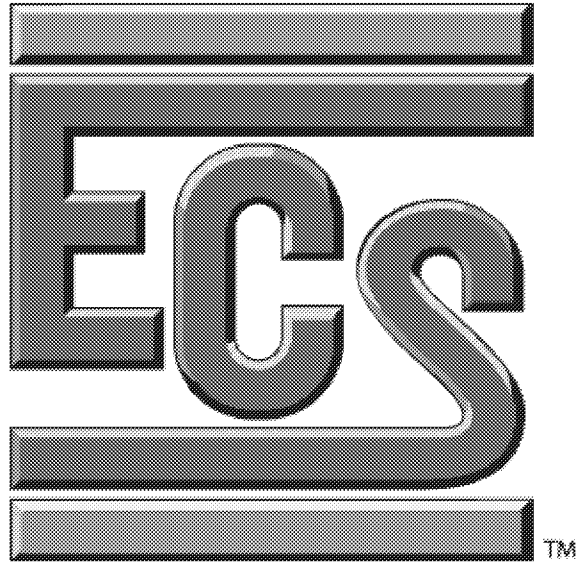
City of Lancaster
Green Infrastructure Program

Site 166:
West Ross Street, from
N Market St to N Queen St

CONCEPT PLAN

- Legend**
- Proposed Inlets
 - Inlet
 - Inlets (IMS Surveyed)
 - Hydrants
 - Manholes
 - ADA Ramps
 - Gravity Sewer Lines
 - 4" - 15" diam.
 - 15" - 30" diam.
 - 30" - 60" diam.
 - 60" - 120" diam.
 - Parcel Boundary
 - Drainage Areas
 - Proposed Bioretention
 - Proposed Infiltration Trench
 - Existing Tree Canopy





REPORT OF

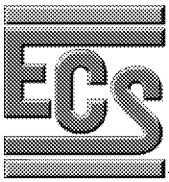
**SUMMARY OF SUBSURFACE EXPLORATION
AND INFILTRATION TESTING SERVICES**

LANCASTER GREEN INFRASTRUCTURE PROJECTS
SITES 162, 165, 166, 134
CITY OF LANCASTER, LANCASTER CO., PA 17603

FOR

CH2M HILL

FEBRUARY 5, 2015



ECS MID-ATLANTIC, LLC

"Setting the Standard for Service"

Geotechnical • Construction Materials • Environmental • Facilities

February 5, 2015

Mr. Andrew Potts, PE
CH2M HILL
1717 Arch Street, Suite 4400
Philadelphia, PA 19103

ECS Job No. 18.3714

Reference: Summary of Subsurface Exploration & Infiltration Testing Services
Proposed City of Lancaster Green Infrastructure Projects
Sites 162, 165, 166, 135
City of Lancaster, Lancaster Co., PA 17603

Dear Mr. Potts:

As authorized by your acceptance of our proposal No. 18.4949-GP dated December 1, 2014, ECS Mid-Atlantic, LLC (ECS), has completed the subsurface exploration and geotechnical engineering analysis at the proposed locations for Green Infrastructure projects. Infiltration testing was performed at various locations on four different sites. Testing was abandoned at a fourth site due to shallow refusal on bedrock. The enclosed report discusses the subsurface exploration procedures, presents the results of our subsurface exploration, and discusses the results of our infiltration testing.

We have enjoyed being of service to CH2M Hill during the design phase of this project. If there are questions regarding the information and geotechnical recommendations contained in this report, please do not hesitate to contact us.

Respectfully submitted,

ECS MID-ATLANTIC, LLC.

J. Matthew Carroll, P.E.
Geotechnical Manager

William D. Friedah, P.E.
Principal Engineer

Alex Redcay, E.I.T.
Geotechnical Staff Project Manager

REPORT

PROJECT

Subsurface Exploration
and Geotechnical Engineering Analysis
Proposed City of Lancaster Green Infrastructure Projects
Lancaster, Lancaster Co., PA 17603

CLIENT

Mr. Andrew Potts, PE
CH2M HILL
1717 Arch Street, Suite 4400
Philadelphia, PA 19103

PROJECT	#18.3714
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DATE	02/05/2015
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PROJECT OVERVIEW

Project Location and Site Description

This report provides a summary of the testing results for sites 162, 165, 166, and 134. Plans depicting the test locations at each site are provided in the Appendix.

Site 162 is located on Walnut Street between N. Christian Street and N. Prince Street. Six locations were selected for infiltration testing, three on each side of Walnut Street. One was located within the roadway, three were located within the sidewalk, and two were located outside of the sidewalk, but still within the right of way.

Site 165 is located on Hershey Avenue between Wabank Street and Hager Street. Three locations for infiltration testing were selected at this site. Two were located on Hershey Street near the intersection with Wabank Street, one in the west bound lane and one near the centerline. The third was in front of the existing Turkey Hill along Hershey Avenue.

Site 166 is located on W Ross Street between N. Queen Street and N. Market Street. Three locations, all in the parking lane, were selected at this site.

An additional test was requested for site 134 on the west side of the intersection of W. Liberty Street and N. Charlotte Street. This area had been previously explored with unsuccessful results due to shallow rock. Testing was unable to be performed at the proposed alternate location due to the presence of shallow rock.

Scope of Work

The conclusions and recommendations contained in this report are based on field subsurface exploration, and review of available geologic and/or geotechnical data. The subsurface exploration consisted of performing soil boring at each location to check for limiting zones, and then performing a cased borehole infiltration test in a second boring offset approximately five feet away. This was done for six locations on Walnut Street, three on Hershey Avenue, and three on Ross Street. Testing at W. Liberty Street was limited to test borings to shallow depths due to shallow bedrock.

The borings were scheduled to be extended to a depth of 10.0 feet below the existing ground surface or to auger refusal, whichever was encountered first followed by cased borehole infiltration testing at a depth of 5.0 feet. Borings were sampled continuously to collect soil profile information. The some of the borings did not reach design depth as portions of the site are underlain by shallow Limestone belonging to the Conestoga Formation.

The number and general locations of borings performed were selected by CH2M Hill and located in the field for drilling purposes by representatives of ECS. The borings were located in the field using standard taping and pacing methods with respect to the existing site features. Several boring locations had to be adjusted due to existing underground utilities. Any significant changes that were made to the boring locations were approved by CH2M Hill before being completed.

EXPLORATION PROCEDURES

Subsurface Exploration Procedures

The soil borings were performed with a truck mounted auger drilling rig where access permitted, and with a Geoprobe drilling rig in the other locations. The drilling rigs utilized continuous flight, hollow stem augers to advance the boreholes. Drilling fluid was not used in this process. Following drilling operations, the boreholes were backfilled with bentonite blended with the auger spoils generated during the drilling process, and then patched with in kind materials (asphalt or concrete).

For the soil borings, representative soil samples were obtained by means of the split-barrel sampling procedure in accordance with ASTM Specification D-1586. In this procedure, a 2-inch O.D., split-barrel sampler is driven into the soil a distance of 24 inches by a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler through a 12-inch interval is termed the Standard Penetration Test (SPT) N-value and is indicated for each sample on the boring logs. This value can be used as a qualitative indication of the in-place relative density of noncohesive soils. In a less reliable way, it also indicates the consistency of cohesive soils. This indication is qualitative, since many factors can significantly affect the standard penetration resistance value and prevent a direct correlation between drill crews, drill rigs, drilling procedures, and hammer-rod-sampler assemblies.

Cased borehole infiltration tests were to be performed next to each boring. The elevation at which the ground was tested was at least 2 feet above any limiting zones that were encountered in the associated soil boring. The actual test location was offset approximately five feet from the original test boring. Casing was sealed with bentonite and allowed time to set before testing was begun. Please see the attached boring layout for more details on test location. The boring numbers correspond to both the site number and the boring number (Ex: first boring at site 162 is B-162-1).

Refer to the Subsurface Exploration Location Diagram in the Appendix for a depiction of the boring and test pit locations.

Regional Geology

According to the Pennsylvania Department of Conservation and Natural Resources Interactive Map (PA DCNR), the site is underlain by The Conestoga Formation (OCc). The *Engineering Characteristics of the Rocks of Pennsylvania*, Second Edition, 1982, by Alan Geyer and Peter Wilshusen, states that the Conestoga formation is a medium-gray, impure limestone having black, graphic shale partings. The joints have an irregular pattern and are poorly developed, moderately abundant and widely spaced. The bedrock formation is moderately resistant to weathering and found to be slightly weathered to a shallow depth. The Conestoga Formation possesses good surface drainage and minor subsurface drainage. Secondary porosity provided by joint and solution-channel openings is of low magnitude and rock permeability that is moderate to low in magnitude. The bedrock is difficult to excavate with pinnacles and numerous quartz veins contributing to the excavation difficulty. Fast drilling rates are obtainable in this bedrock, though rates are slowed by quartz veins. The cut-slope and foundation stability

provided by this bedrock is good, although solution openings and pinnacles should be thoroughly investigated. Limestone is carbonate based and therefore is prone to dissolution in water and karst processes including sinkhole formation. The Conestoga Formation is a good source of road material, riprap, building stone, and fill.

Limestone is a carbonate bedrock formation that is prone to dissolution and sinkhole formation. Sinkholes and closed depressions are not mapped within the City of Lancaster by the Pennsylvania Department of Conservation and Natural Resources Interactive Map due to impervious coverage. However, the Conestoga formation possesses many sinkholes and closed depressions outside of the city limits and therefore it can be assumed that the area within the city that is underlain by this formation is prone to sinkhole formation. The Karst Features Diagram in the Appendix depicts the location of the mapped features. It should be noted that no closed depressions or open sinkholes were identified on the site by ECS during exploration.

Soil Conditions

Surficial materials generally consisted of about 3 to 6 inches of asphalt or concrete (depending on whether the boring was located in the roadway or sidewalk), underlain by 6 to 9 inches of gravel. Boring B-162-2 and four offsets of P-134 encountered 3 to 6 inches of topsoil, due to being drilled in landscape areas.

Borings B-162-1 through B-162-6 were drilled in the vicinity of Walnut St. The existing soils encountered for these borings were mostly silt, with a small amount of clay and sand. Boring B-162-2 encountered FILL which contained clay near the surface but was very coarse at the infiltration depth. The extent of the fill was 6 to 8 feet. Boring B-162-5 was extended beyond 10 feet due to low blow counts, but encountered spoon refusal at 10.6 feet on limestone bedrock.

Borings B-165-1 through B-165-3 were drilled along Hershey Ave. These borings generally encountered silt with trace amounts of sand or clay. It should be noted that the test boring for B-165-3 encountered very soft (Weight-of-Hammer) soils at the test depth of 5 feet. Very soft soils could be indicative of solution activity that could lead to subsidence/sinkholes, or this soft soil may be associated with backfill of previous stormwater pipe location.

Borings B-166-1 through B-166-3 were drilled on W Ross St. and generally encountered clay with some sand, though B-166-2 encountered gravelly sand in the vicinity of the infiltration test depth.

Borings drilled for P-134 (near the intersection of W Liberty St and N Charlotte St) encountered mostly sand and silt, underlain by shallow limestone (2.5 – 6.5 feet below the surface).

Groundwater Conditions

Groundwater seepage was noticed in the bottom of Boring B-165-1. After several hours water was observed in the boring 7.5 feet below the surface. Groundwater was not observed at any other boring locations, including the others on Hershey Ave. It should be noted that groundwater and perched water conditions are influenced by precipitation and seasonality and may change over time.

Infiltration Testing Results

The planned depths for infiltration testing were able to be achieved for all proposed locations except for Boring P-134 and the various offsets at the Liberty Street location. Infiltration testing was done in general accordance with the cased-borehole method. Test readings were recorded at half-hour intervals unless the drop in water level was greater than 2 inches in 30 minutes. A minimum of four consecutive, stable, readings were recorded. The soils tested were not frozen.

Test Location	Test Location	Surface Elevation* (ft)	Infiltration Testing Elevation (ft)	Limiting Layer Elevation (ft)	Corrected Infiltration Rate (in/hr) Safety Factor: 2.0
Walnut Street	B-162-1	359.4	354.4	Not Encountered	2.25
	B-162-2	358.6	353.6	Not Encountered	>10.00
	B-162-3	365.3	360.3	Not Encountered	3.87
	B-162-4	368.7	363.7	361.3	4.95
	B-162-5	377.5	372.5	367.3	0.39
	B-162-6	375.2	370.2	Not Encountered	0.78
Hershey Avenue	B-165-1	318.3	314.0	310.0	0.21
	B-165-2	318.3	313.8	Not Encountered	0.21
	B-165-3	321.3	316.3	311.5	0.24
W. Ross Street	B-166-1	348.9	344.0	Not Encountered	0.63
	B-166-2	348.1	343.4	Not Encountered	1.70**
	B-166-3	347.2	342.4	Not Encountered	0.39
W. Liberty Street	P-134	357.6***	-	351.1 - 355.1***	N/A

* Surface elevation determined by interpolation from existing conditions plan

** Safety Factor of 3.0 used – see explanation below

*** Multiple offset borings, each encountering shallow refusals (2.3' – 6.5')

Based on the results of the infiltration and our observation of the subsurface conditions, the following specific items are noteworthy:

- 1) Boring B162-2 encountered FILL to a depth of 8 feet and the rate of infiltration was very high (well in excess of 10 inches/hour) due to the coarse constituents in the FILL materials. Therefore, over excavation of the basin bottom and replacement with amended soils to slow the rate of infiltration down is recommended. Amended soils should conform to the approximate gradation in the following table, and contain sufficient organic media to provide a suitable Cationic Exchange Capacity (CEC).

Permissible Soil Types for Amended Soil, based on USDA Classification	Ranges of USDA Particle Size Percentages						Typical Infiltration Rates for Permissible Soil Types (in/hr)*	
	Sand		Silt		Clay		Min	Max
	Min	Max	Min	Max	Min	Max		
Sand, Loamy Sand, Sandy Loam, Loam	50	100	0	50	0	20	0.5	8.3

*Theoretical infiltration rates as designated by Rawls, Brakensiek, and Saxton (1982)

With these amended soils, an assumed rate of infiltration for design of 1 inch/hour is recommended. The thickness of amended soils should be a minimum of 2 feet.

- 2) Boring B165-3 recorded very soft materials at about the test depth location. Weight of Hammer (WOH) soils were recorded with the split spoon sampling. Very soft soils could be indicative of potential softening, raveling, or collapse of soils associated with karst (sinkhole) conditions. Alternatively, these soft soils may be associated with FILL soils associated with the previous backfilling of a stormwater pipe that may have been removed. The initial offset boring attempt in this area encountered a large diameter concrete pipe that was unknown to the City, and was apparently partially removed or realigned, since it was not encountered in the second attempt after offsetting in the opposite direction. If this area is developed as a stormwater management area, construction in this area should include close oversight by the engineer, and may require stabilization/remediation in order to facilitate construction.
- 3) Boring B166-2 exhibited infiltration rates well in excess of the other adjacent test locations, therefore a greater factor of safety is recommended when considering the design infiltration rate for this area. The tabulation of test results recommends a factor of safety of 3.0. The elevated rate of infiltration appears to be associated with a granular layer at the approximate test elevation. This layer appears to only be about 1 foot thick.

It is recommended that each site to be developed with a Green Infrastructure project such be designed on a site to site basis using an infiltration test corresponding to the given project location.

Closing

This report has been prepared to aid in the evaluation of this site and to assist the design team with the design of the Green Infrastructure projects. The report scope is limited to this specific project and the location described. The project description represents our current understanding of the significant aspects of the proposed improvements relevant to the geotechnical considerations.

We recommend that the construction activities be monitored by the Geotechnical Engineer of Record or his authorized representative to provide the necessary overview of excavation

activities to verify that subsurface conditions are consistent with those encountered and recorded in the report. We would be pleased to provide these services.

We appreciate this opportunity to be of service to you on this project. If you have questions regarding the information and recommendations contained in this letter, or if we may be of further assistance to you in during planning or construction of this project, please do not hesitate to contact ECS at your convenience.

APPENDIX

Site Location Diagram

Geologic Features Diagram

Karst Features Diagram

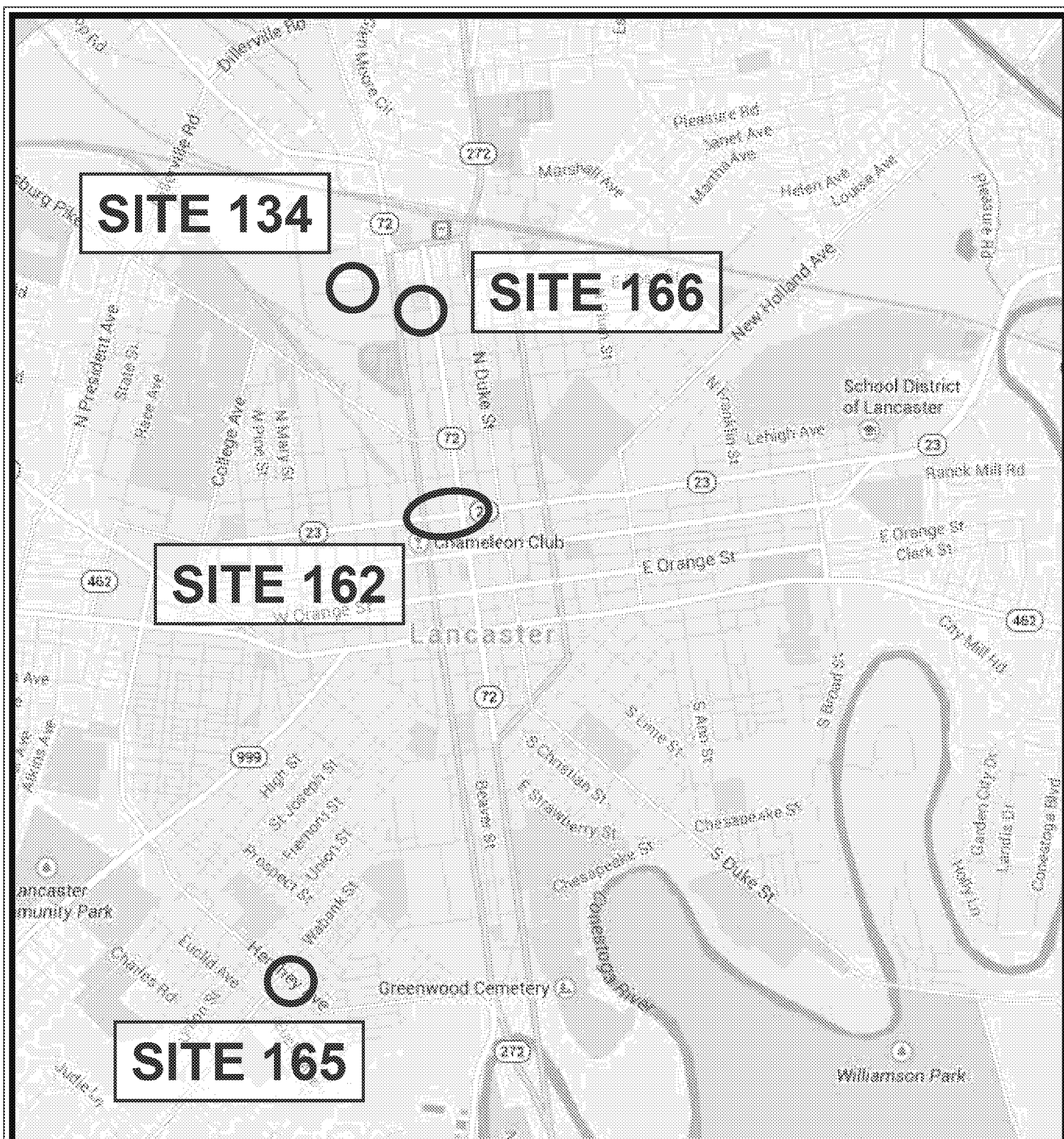
Subsurface Exploration Location Diagrams

Boring Logs

Infiltration Test Results

Unified Soil Classification System

Reference Notes for Boring Logs



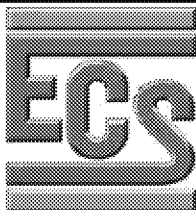
Source: GoogleMaps



City of Lancaster Sites 162, 165, 166, 134

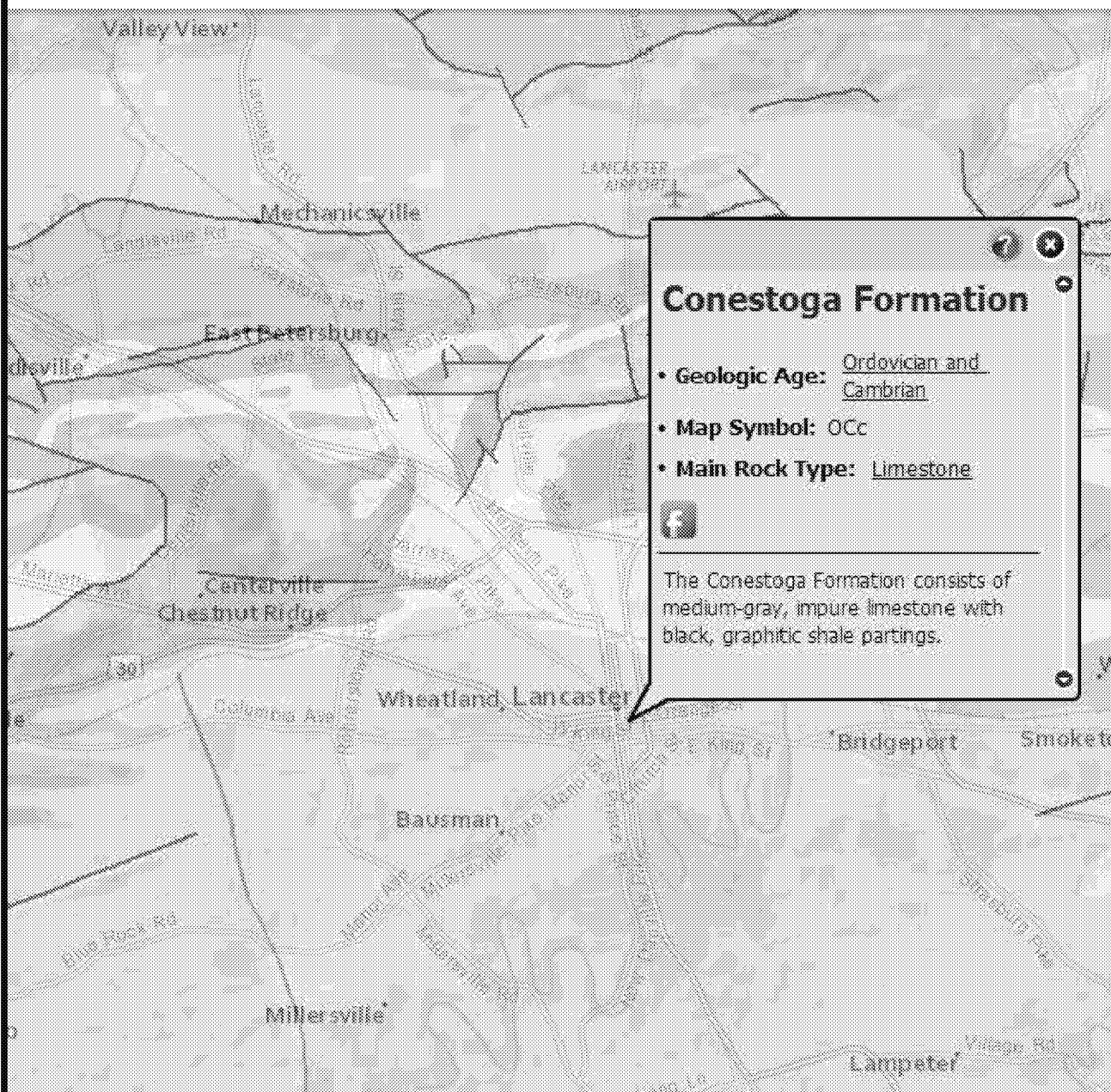
Walnut St, Hershey Ave, W Ross St,
W Liberty St.

Lancaster City
Lancaster County, PA



Appendix

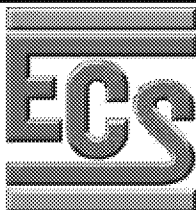
Site Location Diagram
ECS Project 18-3714
January 2015



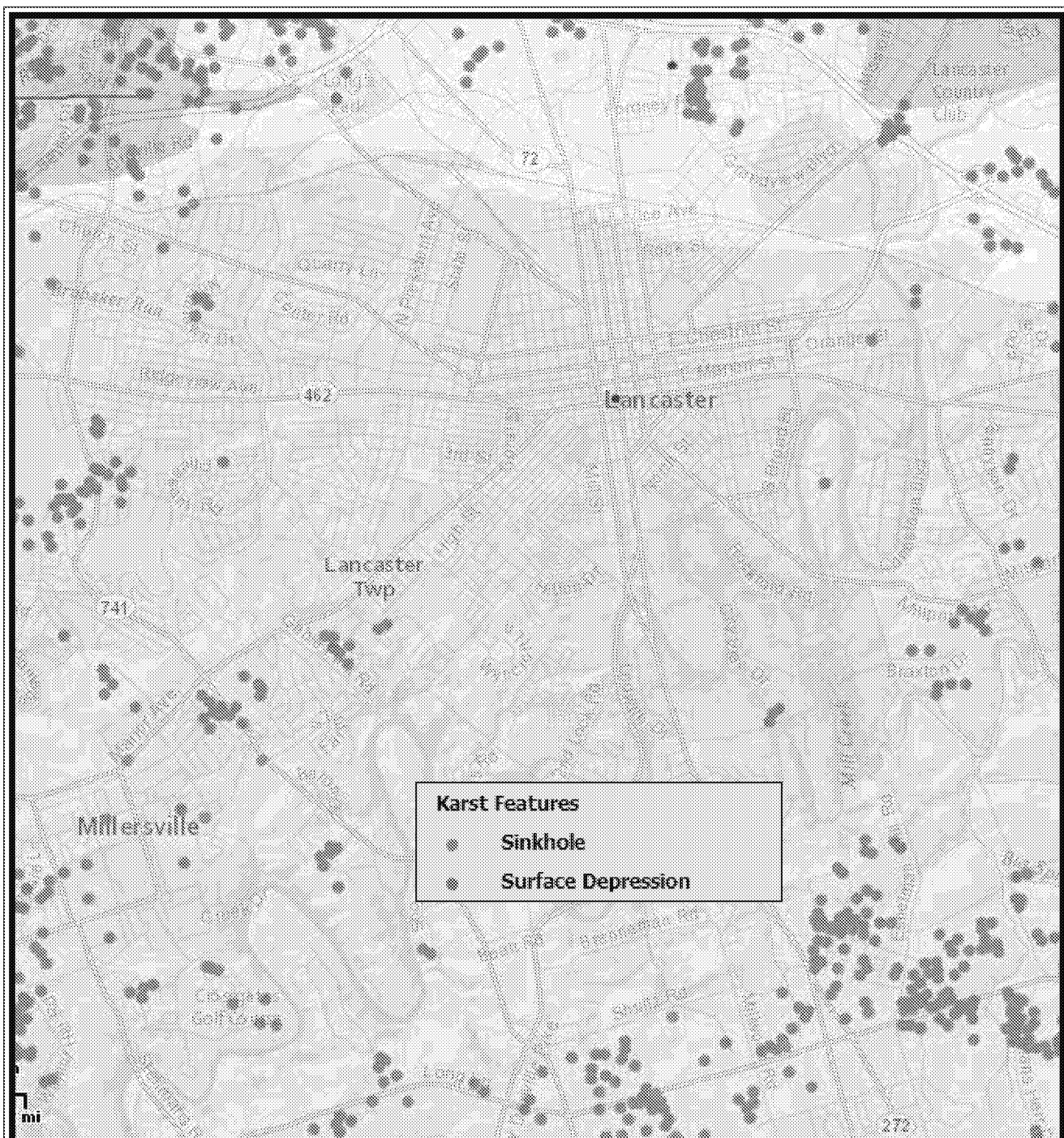
Source: PA D.E.R.



City of Lancaster Sites
162, 165, 166, 134
Walnut St, Hershey Ave, W Ross St,
W Liberty St.
Lancaster City
Lancaster County, PA



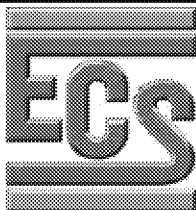
Appendix
Geology Map
ECS Project 18.3714
January 2015



Source: PA D.E.R.



City of Lancaster Sites
162, 165, 166, 134
Walnut St, Hershey Ave, W Ross St,
W Liberty St.
Lancaster City
Lancaster County, PA

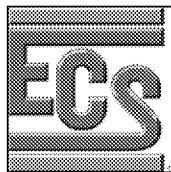


Appendix
Karst Map
ECS Project 18.3714
January 2015



BORING LOCATION DIAGRAM

CH2M Hill



City of Lancaster Site 162

Lancaster Co., PA

ENGINEER JMC	SCALE NTS
DRAFTSMAN ALR	PROJECT NO. 18.3714
REVISIONS 1/16/2015	SHEET 1
	DATE 1/6/2015



**BORING LOCATION
DIAGRAM**

CH2M Hill



**Lancaster City
Site 165**

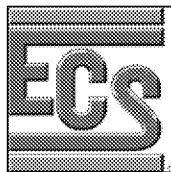
Lancaster, PA

ENGINEER JMC	SCALE
DRAFTSMAN JMC	PROJECT NO. 3714
REVISIONS	SHEET 1
	DATE 01-15-15



**BORING LOCATION
DIAGRAM**

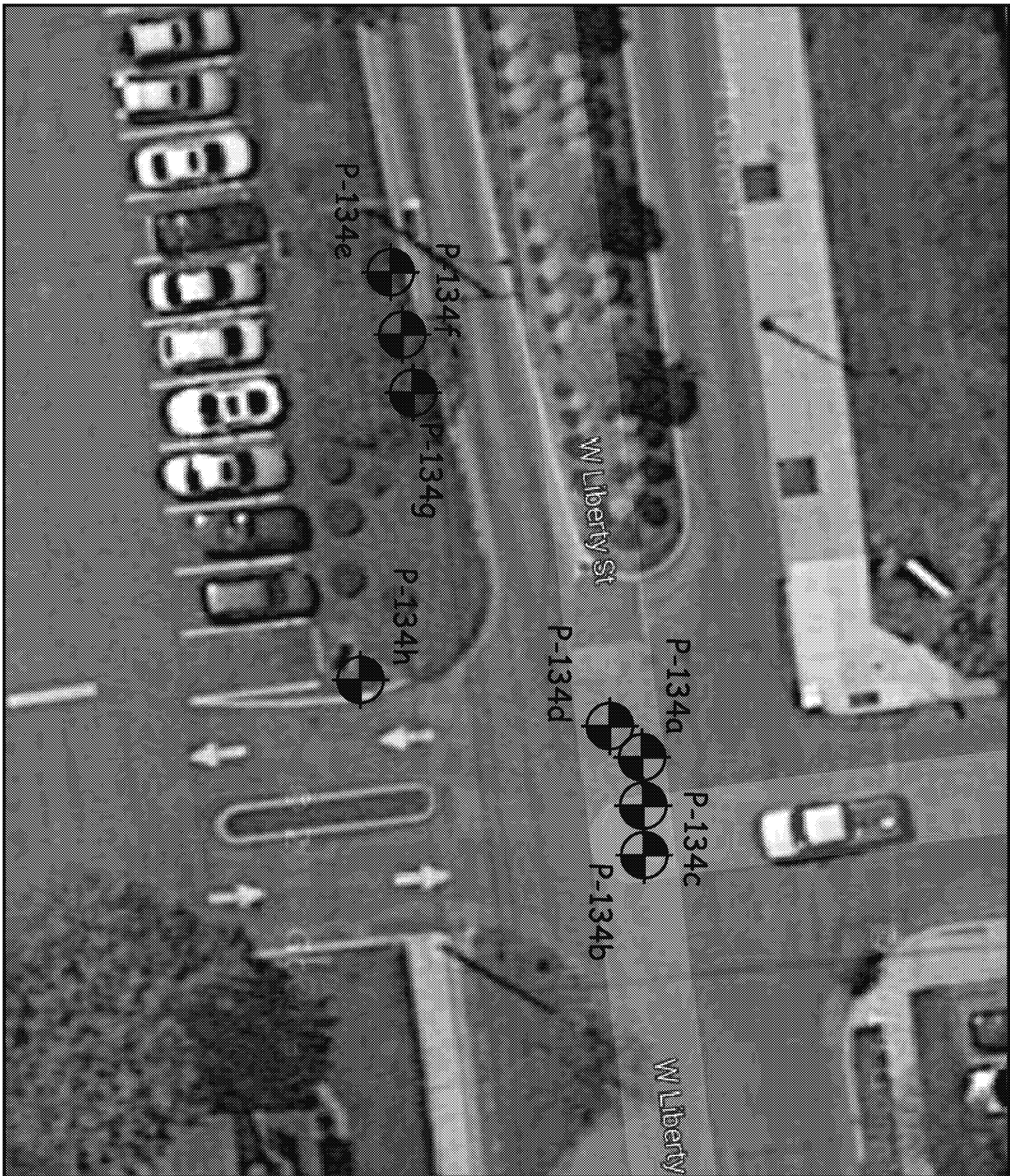
CH2M Hill



**City of Lancaster
Site 166**

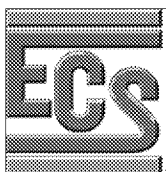
Lancaster Co., PA

ENGINEER JMC	SCALE NTS
DRAFTSMAN ALR	PROJECT NO. 18.3714
REVISIONS	SHEET 1
	DATE 1/27/2015



**BORING LOCATION
DIAGRAM**

CH2M Hill



**City of Lancaster
Site 134 - Additional**

Lancaster Co., PA

ENGINEER JMC	SCALE NTS
DRAFTSMAN ALR	PROJECT NO. 18.3714
REVISIONS	SHEET 1
	DATE 1/27/2015

CLIENT CH2M HILL				JOB # 18.3714		BORING # B-162-1		SHEET 1 OF 1		
PROJECT NAME City of Lancaster Green Infrastructure Projects Sites 162, 165, 166, 135				ARCHITECT-ENGINEER CH2M Hill						
SITE LOCATION Walnut St, Hershey Ave, W Ross St, Lancaster, Lancaster County										
NORTHING		EASTING		STATION		<div style="display: flex; justify-content: space-between;"> <div> ○ CALIBRATED PENETROMETER TONS/FT² ROCK QUALITY DESIGNATION & RECOVERY RQD% - - - - - REC% - - - - - </div> <div> PLASTIC LIMIT% X WATER CONTENT% ● LIQUID LIMIT% △ ⊗ STANDARD PENETRATION BLOWS/FT </div> </div>				
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL					
					BOTTOM OF CASING LOSS OF CIRCULATION					
					SURFACE ELEVATION 359.4					
0					Concrete Depth [2"], Gravel Depth [10"], Topsoil Depth [36"]					
2.5	S-1	SS	24	6						
	S-2	SS	18	6						
5	S-3	SS	24	24						
	S-4	SS	24	0						
7.5					(CL/ML) SILTY CLAY, Brown, Dry to Moist, Medium Stiff					
	S-5	SS	24	24						
10										
12.5					END OF BORING @ 10.00'					
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.										
WL		WS <input type="checkbox"/>		WD <input type="checkbox"/>		BORING STARTED		01/29/15		
WL(BCR)		WL(ACR)				BORING COMPLETED		01/29/15		
WL						RIG Geoprobe		FOREMAN		
						DRILLING METHOD Hollow Stem Auger				

CLIENT CH2M HILL				JOB # 18.3714		BORING # B-162-2		SHEET 1 OF 1		
PROJECT NAME City of Lancaster Green Infrastructure Projects Sites 162, 165, 166, 135				ARCHITECT-ENGINEER CH2M Hill						
SITE LOCATION Walnut St, Hershey Ave, W Ross St, Lancaster, Lancaster County										
NORTHING		EASTING		STATION		<div style="display: flex; justify-content: space-between;"> <div> ○ CALIBRATED PENETROMETER TONS/FT² ROCK QUALITY DESIGNATION & RECOVERY RQD% - - - - - REC% - - - - - PLASTIC LIMIT% WATER CONTENT% LIQUID LIMIT% ✕ ● ▲ ⊗ STANDARD PENETRATION BLOWS/FT </div> </div>				
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ENGLISH UNITS	WATER LEVELS ELEVATION (FT)	BLOWS/6"		
					BOTTOM OF CASING LOSS OF CIRCULATION					
					SURFACE ELEVATION 358.6					
0					Topsoil Depth [6"]					
	S-1	SS	24	8	(CL/ML FILL) SILTY CLAY, Brown, Dry, Soft		357.5	5		
2.5	S-2	SS	24	24	(SM/ML FILL) SILTY SAND/SANDY SILT, Contains Slight Concrete Rock Fragments, Black, Dry to Wet, Medium Dense to Loose, Contains Coal Dust		355	30		
5	S-3	SS	24	16			352.5	4		
7.5	S-4	SS	24	24	(CL FILL) LEAN CLAY, Trace Silt, Brown, Moist, Soft, Contains Slight Coal Dust		350	7		
10	S-5	SS	24	24	(CL/ML) SILTY CLAY, Dull Brown, Moist to Wet, Medium Stiff		347.5	4		
12.5	S-6	SS	24	24	(ML) SILT, Dull Brown, Moist, Loose					
					END OF BORING @ 12.00'					
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.										
WL		WS		WD		BORING STARTED 01/29/15				
WL(BCR)		WL(ACR)				BORING COMPLETED 01/29/15		CAVE IN DEPTH		
WL						RIG Geoprobe FOREMAN		DRILLING METHOD Hollow Stem Auger		

CLIENT CH2M HILL				JOB # 18.3714		BORING # B-162-3		SHEET 1 OF 1		
PROJECT NAME City of Lancaster Green Infrastructure Projects				ARCHITECT-ENGINEER CH2M Hill						
SITES 162, 165, 166, 135										
SITE LOCATION Walnut St, Hershey Ave, W Ross St, Lancaster, Lancaster County										
NORTHING		EASTING		STATION						
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL		ENGLISH UNITS		WATER LEVELS ELEVATION (FT)	BLOWS/6"
					BOTTOM OF CASING LOSS OF CIRCULATION					
					SURFACE ELEVATION 365.3					
<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>Topsoil Depth [9"]</p> <p>(ML) SILT, Dull to Light Brown, Dry, Loose</p> <p>(ML) SILT WITH SAND, Light Brown, Dry to Moist, Loose</p> <p>END OF BORING @ 10.00'</p> </div> <div style="width: 5%; text-align: center;"> </div> <div style="width: 45%; text-align: right;"> <p>365</p> <p>362.5</p> <p>360</p> <p>357.5</p> <p>355</p> </div> </div>										
0										
2.5	S-1	SS	24	12						6
										6
5	S-2	SS	18	15						7
										5
7.5	S-3	SS	24	24						7
										7
10	S-4	SS	24	24						
12.5	S-5	SS	24	24						

○ CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% - - - - - REC% - - - - -

PLASTIC LIMIT% WATER CONTENT% LIQUID LIMIT%

⊗ STANDARD PENETRATION BLOWS/FT

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL <input type="checkbox"/> WS <input type="checkbox"/> WD <input type="checkbox"/>	BORING STARTED 01/29/15	
WL(BCR) <input type="checkbox"/> WL(ACR) <input type="checkbox"/>	BORING COMPLETED 01/29/15	CAVE IN DEPTH
WL <input type="checkbox"/>	RIG Geoprobe FOREMAN	DRILLING METHOD Hollow Stem Auger

CLIENT CH2M HILL				JOB # 18.3714		BORING # B-162-4		SHEET 1 OF 1		
PROJECT NAME City of Lancaster Green Infrastructure Projects				ARCHITECT-ENGINEER CH2M Hill						
SITES 162, 165, 166, 135										
SITE LOCATION Walnut St, Hershey Ave, W Ross St, Lancaster, Lancaster County										
NORTHING		EASTING		STATION		○ CALIBRATED PENETROMETER TONS/FT ² ROCK QUALITY DESIGNATION & RECOVERY RQD% --- REC% --- PLASTIC LIMIT% WATER CONTENT% LIQUID LIMIT% ✕ ● ▲ ⊗ STANDARD PENETRATION BLOWS/FT				
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ENGLISH UNITS	WATER LEVELS ELEVATION (FT)	BLOWS/6"		
					BOTTOM OF CASING	LOSS OF CIRCULATION				
					SURFACE ELEVATION 368.7					
0					Concrete Depth [2"], Gravel Depth [4"]					
	S-1	SS	18	14	(SM/ML) SILTY FINE SAND/SANDY SILT, Dull Brown, Dry, Loose		367.5	4 2 2	4	
2.5	S-2	SS	24	12			365	4 3 3	6	
5	S-3	SS	24	18	(ML) SILT WITH SAND, Contains Slight Mica, Brown, Moist to Wet, Loose to Very Dense		362.5	2 3 4	6	
	S-4	SS	17	8			357.5	7 22 50/5	72/11	
7.5					SPOON REFUSAL @ 7.42'					
10										
12.5										
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.										
WL		WS		WD		BORING STARTED		01/23/15		
WL(BCR)		WL(ACR)				BORING COMPLETED		01/23/15		
WL						RIG Geoprobe		FOREMAN		
						DRILLING METHOD		Hollow Stem Auger		

ED 006502 00000056-00029

ED 006502 00000056-00030

CLIENT CH2M HILL				JOB # 18.3714		BORING # B-165-1		SHEET 1 OF 1					
PROJECT NAME City of Lancaster Green Infrastructure Projects Sites 162, 165, 166, 135				ARCHITECT-ENGINEER CH2M Hill									
SITE LOCATION Walnut St, Hershey Ave, W Ross St, Lancaster, Lancaster County													
NORTHING		EASTING		STATION		<div style="display: flex; justify-content: space-between;"> <div> <p>○ CALIBRATED PENETROMETER TONS/FT²</p> <p>ROCK QUALITY DESIGNATION & RECOVERY</p> <p>RQD% - - - - - REC% - - - - -</p> <p>PLASTIC LIMIT% WATER CONTENT% LIQUID LIMIT%</p> <p>✕ ● ▲</p> <p>⊗ STANDARD PENETRATION BLOWS/FT</p> </div> </div>							
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL						ENGLISH UNITS	WATER LEVELS ELEVATION (FT)	BLOWS/6"
					BOTTOM OF CASING						LOSS OF CIRCULATION		
					SURFACE ELEVATION 318.3								
0					Asphalt Depth [5"], Gravel Depth [7"]		317.5						
2.5	S-1	SS	18	16	(ML) SILT, Trace Sand, Grayish Brown, Dry, Loose		315	7 ⊗					
	S-2	SS	18	18				4 ⊗					
5	S-3	SS	24	20			312.5	6 ⊗					
	S-4	SS	24	21				9 ⊗					
7.5	S-5	SS	4	4			310	50/4 ⊗					
10					AUGER REFUSAL @ 8.33'		307.5						
12.5													
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.													
WL 8.33		WS <input type="checkbox"/>		WD <input type="checkbox"/>		BORING STARTED 01/14/15							
WL(BCR)		WL(ACR)				BORING COMPLETED 01/14/15		CAVE IN DEPTH					
WL 7.50		3 hours				RIG CME 55 FOREMAN		DRILLING METHOD Hollow Stem Auger					

CLIENT CH2M HILL				JOB # 18.3714		BORING # B-165-2		SHEET 1 OF 1		
PROJECT NAME City of Lancaster Green Infrastructure Projects Sites 162, 165, 166, 135				ARCHITECT-ENGINEER CH2M Hill						
SITE LOCATION Walnut St, Hershey Ave, W Ross St, Lancaster, Lancaster County										
NORTHING		EASTING		STATION		○ CALIBRATED PENETROMETER TONS/FT ² ROCK QUALITY DESIGNATION & RECOVERY RQD% - - - - - REC% - - - - - PLASTIC LIMIT% WATER CONTENT% LIQUID LIMIT% ✕ ● ▲ ⊗ STANDARD PENETRATION BLOWS/FT				
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	ENGLISH UNITS	WATER LEVELS ELEVATION (FT)	BLOWS/6"		
					BOTTOM OF CASING	LOSS OF CIRCULATION				
					SURFACE ELEVATION 318.3					
0					Asphalt Depth [5"], Gravel Depth [7"]		317.5			
2.5	S-1	SS	18	18	(ML) SILT, Trace Sand, Grayish Brown, Dry, Medium Dense		315	12		
	S-2	SS	18	18				18		
5	S-3	SS	24	24	(ML) SILT, Trace Sand, Trace Clay, Dull Brown, Dry, Medium Dense to Dense		312.5	34		
	S-4	SS	24	24				13		
7.5					(ML) SILT, Grayish Dark Brown, Moist, Loose		310	9		
10	S-5	SS	24	24						
12.5					END OF BORING @ 10.00'		307.5			
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.										
WL		WS		WD		BORING STARTED 01/15/15				
WL(BCR)		WL(ACR)				BORING COMPLETED 01/15/15		CAVE IN DEPTH		
WL						RIG CME 55 FOREMAN		DRILLING METHOD Hollow Stem Auger		

CLIENT CH2M HILL				JOB # 18.3714		BORING # B-165-3		SHEET 1 OF 1					
PROJECT NAME City of Lancaster Green Infrastructure Projects Sites 162, 165, 166, 135				ARCHITECT-ENGINEER CH2M Hill									
SITE LOCATION Walnut St, Hershey Ave, W Ross St, Lancaster, Lancaster County													
NORTHING		EASTING		STATION		<div style="display: flex; justify-content: space-between;"> <div> <p>○ CALIBRATED PENETROMETER TONS/FT²</p> <p>ROCK QUALITY DESIGNATION & RECOVERY</p> <p>RQD% - - - - - REC% - - - - -</p> <p>PLASTIC LIMIT% WATER CONTENT% LIQUID LIMIT%</p> <p>✕ ● ▲</p> <p>⊗ STANDARD PENETRATION BLOWS/FT</p> </div> </div>							
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL						ENGLISH UNITS	WATER LEVELS ELEVATION (FT)	BLOWS/6"
					BOTTOM OF CASING						LOSS OF CIRCULATION		
					SURFACE ELEVATION 321.3								
0					Concrete Depth [2"], Gravel Depth [4"]								
	S-1	SS	15	6	(GP) WEATHERED LIMESTONE SAMPLED AS GRAVEL WITH SAND, Gray, Dry, Very Dense		320	6 4 50/3					
2.5					(CL) SANDY LEAN CLAY, Brown, Dry, Soft		317.5	3 3					
	S-2	SS	12	12	(CL) LEAN CLAY, Brown, Dry, Very Soft								
5					(CL/ML) SILTY CLAY, Brown, Moist, Soft		315	1 1 4 5					
	S-3	SS	24	16	(ML) SILT, Gray, Moist, Very Stiff		312.5	8 10 21 50/3					
7.5													
	S-4	SS	24	6									
	S-5	SS	21	12									
10					SPOON REFUSAL @ 9.75'								
12.5													
<p>THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.</p>													
WL		WS		WD		BORING STARTED 01/22/15							
WL(BCR)		WL(ACR)				BORING COMPLETED 01/22/15		CAVE IN DEPTH					
WL						RIG Geoprobe FOREMAN		DRILLING METHOD Hollow Stem Auger					

CLIENT CH2M HILL				JOB # 18.3714		BORING # B-166-1		SHEET 1 OF 1					
PROJECT NAME City of Lancaster Green Infrastructure Projects Sites 162, 165, 166, 135				ARCHITECT-ENGINEER CH2M Hill									
SITE LOCATION Walnut St, Hershey Ave, W Ross St, Lancaster, Lancaster County													
NORTHING		EASTING		STATION		<div style="display: flex; justify-content: space-between;"> <div> ○ CALIBRATED PENETROMETER TONS/FT² ROCK QUALITY DESIGNATION & RECOVERY RQD% - - - - - REC% - - - - - </div> <div> PLASTIC LIMIT% X WATER CONTENT% ● LIQUID LIMIT% △ ⊗ STANDARD PENETRATION BLOWS/FT </div> </div>							
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL						ENGLISH UNITS	WATER LEVELS ELEVATION (FT)	BLOWS/6"
					BOTTOM OF CASING						LOSS OF CIRCULATION		
					SURFACE ELEVATION 348.9								
0					Asphalt Depth [6"], Gravel Depth [3"]								
					(CL) SANDY LEAN CLAY, Reddish Orange, Moist, Medium Stiff to Stiff		347.5						
2.5	S-1	SS	24	15				7 ⊗					
	S-2	SS	24	23			345	12 ⊗					
5					(CL) SANDY LEAN CLAY, Trace Gravel, Reddish Orange, Moist, Soft to Medium Stiff								
	S-3	SS	24	7			342.5	9 ⊗					
7.5	S-4	SS	24	14	(CL) SANDY LEAN CLAY, Orange to Brown, Moist, Stiff		340	12 ⊗					
10	S-5	SS	18	14	(CL) SANDY LEAN CLAY, Tannish Orange, Dry, Stiff			13 ⊗					
12.5					END OF BORING @ 10.50'		337.5						

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

<div style="display: flex; justify-content: space-between;"> <div> <div></div> WL <div><div></div> WS</div> <div><div></div> WD</div> </div> <div> BORING STARTED 01/23/15 </div> </div>
<div style="display: flex; justify-content: space-between;"> <div> <div></div> WL(BCR) <div><div></div> WL(ACR)</div> </div> <div> BORING COMPLETED 01/23/15 </div> <div>CAVE IN DEPTH</div> </div>
<div style="display: flex; justify-content: space-between;"> <div><div></div> WL</div> <div> RIG CME 55 </div> <div>FOREMAN</div> </div>
DRILLING METHOD

CLIENT CH2M HILL				JOB # 18.3714		BORING # B-166-2		SHEET 1 OF 1																																																																																																																																						
PROJECT NAME City of Lancaster Green Infrastructure Projects				ARCHITECT-ENGINEER CH2M Hill																																																																																																																																										
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DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL		ENGLISH UNITS		WATER LEVELS ELEVATION (FT)	BLOWS/6"																																																																																																																																				
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<div style="display: flex; justify-content: space-between;"> <div style="width: 60%;"> <table border="1" style="width:100%; border-collapse: collapse;"> <tr> <td style="width: 5%;">0</td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 40%;">Asphalt Depth [6"], Gravel Depth [3"]</td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> <td style="width: 5%;"></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td>(CL) SANDY LEAN CLAY, Orange to Brown, Moist, Medium Stiff</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2.5</td> <td>S-1</td> <td>SS</td> <td>24</td> <td>20</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td>(CL) SANDY LEAN CLAY, Trace Gravel, Orange to Brown, Moist, Stiff</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>5</td> <td>S-2</td> <td>SS</td> <td>24</td> <td>24</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td>(GW-SW) WELL GRADED SAND WITH GRAVEL, Trace Clay, Gray to Brown, Dry, Medium Dense</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>7.5</td> <td>S-3</td> <td>SS</td> <td>24</td> <td>4</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td>(CL) SANDY LEAN CLAY, Trace Gravel, Orange to Brown, Moist, Very Soft to Medium Dense</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>10</td> <td>S-4</td> <td>SS</td> <td>24</td> <td>11</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td></td> <td>S-5</td> <td>SS</td> <td>18</td> <td>7</td> <td></td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>12.5</td> <td></td> <td></td> <td></td> <td></td> <td>END OF BORING @ 10.50'</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> </table> </div> <div style="width: 35%;"> <p> CALIBRATED PENETROMETER TONS/FT² ROCK QUALITY DESIGNATION & RECOVERY RQD% - - - - - REC% - - - - - PLASTIC LIMIT% WATER CONTENT% LIQUID LIMIT% STANDARD PENETRATION BLOWS/FT </p> </div> </div>											0					Asphalt Depth [6"], Gravel Depth [3"]											(CL) SANDY LEAN CLAY, Orange to Brown, Moist, Medium Stiff						2.5	S-1	SS	24	20												(CL) SANDY LEAN CLAY, Trace Gravel, Orange to Brown, Moist, Stiff						5	S-2	SS	24	24												(GW-SW) WELL GRADED SAND WITH GRAVEL, Trace Clay, Gray to Brown, Dry, Medium Dense						7.5	S-3	SS	24	4												(CL) SANDY LEAN CLAY, Trace Gravel, Orange to Brown, Moist, Very Soft to Medium Dense						10	S-4	SS	24	11																			S-5	SS	18	7							12.5					END OF BORING @ 10.50'					
0					Asphalt Depth [6"], Gravel Depth [3"]																																																																																																																																									
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CLIENT CH2M HILL				JOB # 18.3714		BORING # B-166-3		SHEET 1 OF 1					
PROJECT NAME City of Lancaster Green Infrastructure Projects Sites 162, 165, 166, 135				ARCHITECT-ENGINEER CH2M Hill									
SITE LOCATION Walnut St, Hershey Ave, W Ross St, Lancaster, Lancaster County													
NORTHING		EASTING		STATION		<div style="display: flex; justify-content: space-between;"> <div> <p>○ CALIBRATED PENETROMETER TONS/FT²</p> <p>ROCK QUALITY DESIGNATION & RECOVERY</p> <p>RQD% - - - - - REC% - - - - -</p> <p>PLASTIC LIMIT% WATER CONTENT% LIQUID LIMIT%</p> <p>✕ ● ▲</p> <p>⊗ STANDARD PENETRATION BLOWS/FT</p> </div> </div>							
DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL						ENGLISH UNITS	WATER LEVELS ELEVATION (FT)	BLOWS/6"
					BOTTOM OF CASING						LOSS OF CIRCULATION		
					SURFACE ELEVATION 347.2								
0					Asphalt Depth [5"], Gravel Depth [2"]								
					(CL) SANDY LEAN CLAY, Red to Brown, Moist, Stiff								
2.5	S-1	SS	24	13			345	11					
					(CL) SANDY LEAN CLAY, Trace Gravel, Red to Orange, Moist, Very Stiff		342.5	16					
5	S-2	SS	24	23									
					(CL) SANDY LEAN CLAY, Orange to Brown, Moist, Medium Stiff to Stiff		340	8					
7.5	S-3	SS	24	14									
							337.5	13					
10	S-4	SS	24	17									
								10					
12.5	S-5	SS	18	18									
					END OF BORING @ 10.50'								
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.													
WL		WS		WD		BORING STARTED 01/23/15							
WL(BCR)		WL(ACR)				BORING COMPLETED 01/23/15		CAVE IN DEPTH					
WL						RIG CME 55 FOREMAN		DRILLING METHOD					

ED 006502 00000056-00037

ECS Project # 18.3714
City of Lancaster Site 162 (Walnut St.)
Infiltration Testing Field Measurements

Date Tested:	1/29/2015			1/30/2015			1/29/2015			1/23/2015			1/23/2015		
Field Data	B-162-1			B-162-2			B-162-3			B-162-4			B-162-5		
Test Depth (ft)	5.00', EL 354.4			5.00', EL 353.6			5.00', EL 360.3			5.00', EL 363.7			5.00', EL 372.5		
	Time	Reading	Drop	Time	Reading	Drop	Time	Reading	Drop	Time	Reading	Drop	Time	Reading	Drop
START TEST	14:16	2.60	-	0.0	3.05	-	12:48	3.06	-	14:41	3.00	-	12:02	3.18	-
Reading Interval	30 min			0.5 min			10 min			10 min			30 min		
Reading # 1 (ft)	14:46	2.75	0.15	0.5	4.40	1.35	12:58	3.49	0.43	14:51	3.25	0.25	12:32	3.22	0.04
Reading # 2 (ft)	15:16	2.98	0.23	1.0	4.63	0.23	13:08	3.62	0.13	15:01	3.40	0.15	13:02	3.25	0.03
Reading # 3 (ft)	15:46	3.22	0.24	1.5	4.80	0.17	13:18	3.73	0.11	15:11	3.55	0.15	13:32	3.27	0.02
Reading # 4 (ft)	16:16	3.35	0.13	2.0	5.05	0.25	13:28	3.84	0.11	15:21	3.68	0.13	14:02	3.31	0.04
Reading # 5 (ft)							13:38	3.92	0.08	15:31	3.80	0.12			
Reading # 6 (ft)															
Reading # 7 (ft)															
Reading # 8 (ft)															
Diameter of Hole (in)	4.00			4.00			4.00			4.00			4.00		
Final Water Level Drop (ft)	0.13			0.25			0.08			0.12			0.04		
Average Reading (ft)	0.188			0.500			0.108			0.138			0.033		
Infiltration Rate (in/hr)	4.50			720.00			7.74			9.90			0.78		
Safety Factor	2.00			2.00			2.00			2.00			2.00		
Corrected Infiltration Rate (in/hr)	2.25			360.00			3.87			4.95			0.39		

Notes:

1. Tested with Cased Borehole Method

ECS Project # 18.3714
City of Lancaster Site 162 (Walnut St.)
Infiltration Testing Field Measurements

Date Tested: 1/23/2015

Field Data Test Depth (ft)	B-162-6														
	5.00, EL 370.2														
	Time	Reading	Drop	Time	Reading	Drop	Time	Reading	Drop	Time	Reading	Drop	Time	Reading	Drop
START TEST	10:27	2.68	-			-			-			-			-
Reading Interval	30 min														
Reading # 1 (ft)	10:57	2.73	0.05												
Reading # 2 (ft)	11:27	2.81	0.08												
Reading # 3 (ft)	11:57	2.88	0.07												
Reading # 4 (ft)	12:27	2.94	0.06												
Reading # 5 (ft)															
Reading # 6 (ft)															
Reading # 7 (ft)															
Reading # 8 (ft)															
Diameter of Hole (in)	4.00														
Final Water Level Drop (ft)	0.06														
Average Reading (ft)	0.065														
Infiltration Rate (in/hr)	1.56														
Safety Factor	2.00														
Corrected Infiltration Rate (in/hr)	0.78														

Notes:

1. Tested with Cased Borehole Method

ECS Project # 18.3714
City of Lancaster Site 165 (Hershey Ave.)
Infiltration Testing Field Measurements

Date Tested:	1/14/2015			1/15/2015			1/30/2015		
Field Data	B-165-1			B-165-2			B-165-3		
Test Depth (ft)	4.25', EL 314.0			4.50', EL 313.8			5.00', EL 316.3		
	Time	Reading	Drop	Time	Reading	Drop	Time	Reading	Drop
START TEST	14:14	5.90	-	9:54	5.05	-	10:40	3.05	-
Reading Interval	30 min			30 min			30 min		
Reading # 1 (ft)	14:44	5.95	0.05	10:24	5.08	0.03	11:10	3.09	0.04
Reading # 2 (ft)	15:14	5.96	0.01	10:54	5.09	0.01	11:40	3.11	0.02
Reading # 3 (ft)	15:44	5.96	0.00	11:24	5.10	0.01	12:10	3.13	0.02
Reading # 4 (ft)	16:14	5.97	0.01	11:54	5.12	0.02	12:40	3.13	0.00
Reading # 5 (ft)									
Reading # 6 (ft)									
Reading # 7 (ft)									
Reading # 8 (ft)									
Diameter of Hole (in)	6.00			6.00			4.00		
Final Water Level Drop (ft)	0.01			0.02			0.00		
Average Reading (ft)	0.017			0.018			0.020		
Infiltration Rate (in/hr)	0.42			0.42			0.48		
Safety Factor	2.00			2.00			2.00		
Corrected Infiltration Rate (in/hr)	0.21			0.21			0.24		

Notes:

1. Tested with Cased Borehole Method

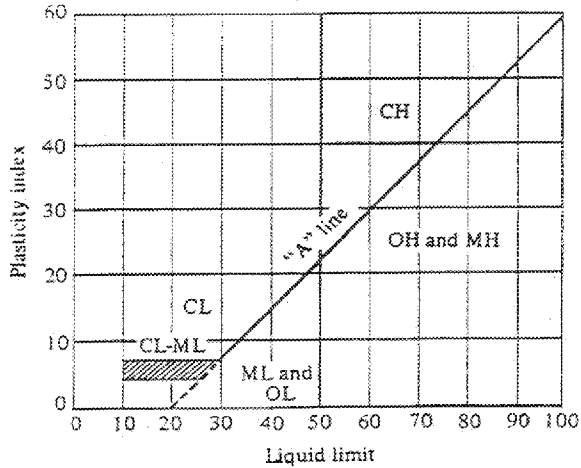
ECS Project # 18.3714
City of Lancaster Site 166 (W Ross St.)
Infiltration Testing Field Measurements

Date Tested:	1/23/2015			1/23/2015			1/23/2015		
Field Data	B-166-1			B-166-2			B-166-3		
Test Depth (ft)	4.91', EL 344.0			4.70', EL 343.4			4.83', EL 342.4		
	Time	Reading	Drop	Time	Reading	Drop	Time	Reading	Drop
START TEST	12:42	2.78	-	11:47	2.55	-	10:50	2.10	-
Reading Interval	30 min			30 min			30 min		
Reading # 1 (ft)	13:22	2.87	0.09	12:17	2.90	0.35	11:20	2.13	0.03
Reading # 2 (ft)	13:42	2.90	0.03	12:47	3.15	0.25	11:50	2.16	0.03
Reading # 3 (ft)	14:12	2.93	0.03	13:17	3.28	0.13	12:20	2.20	0.04
Reading # 4 (ft)	14:42	2.99	0.06	13:47	3.40	0.12	12:50	2.23	0.03
Reading # 5 (ft)									
Reading # 6 (ft)									
Reading # 7 (ft)									
Reading # 8 (ft)									
Diameter of Hole (in)	4.00			4.00			4.00		
Final Water Level Drop (ft)	0.06			0.12			0.03		
Average Reading (ft)	0.053			0.213			0.033		
Infiltration Rate (in/hr)	1.26			5.10			0.78		
Safety Factor	2.00			3.00			2.00		
Corrected Infiltration Rate (in/hr)	0.63			1.70			0.39		

Notes:

1. Tested with Cased Borehole Method

Unified Soil Classification System (ASTM D-2487)

Major Divisions				Group Symbols	Typical Names	Laboratory Classification Criteria			
<div>Coarse-grained soils (More than half of material is larger than No. 200 sieve size)</div> <div>Gravels (More than half of coarse fraction is larger than No. 4 sieve size)</div> <div>Gravels with fines (Appreciable Amount of fines)</div> <div>Gravels with fines (Little or no fines)</div> <div>GP</div> <div>GW</div> <div>Well-graded gravels, gravel-sand mixtures, little or no fines</div> <div>Poorly-graded gravels, gravel-sand mixtures, little or no fines</div> <div>GM^a</div> <div>d</div> <div>u</div> <div>Silty gravels, gravel-sand-silt mixtures</div> <div>GC</div> <div>Clayey Gravels, gravel-sand-clay mixtures</div> <div>SW</div> <div>Well-graded sands, gravelly sands, little or no fines</div> <div>SP</div> <div>Poorly-graded sands, gravelly sands, little or no fines</div> <div>SM^a</div> <div>d</div> <div>u</div> <div>Silty sands, sand-silt mixtures</div> <div>SC</div> <div>Clayey sands, sand-clay mixtures</div> <div>Determine percentages of sand and gravel from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size), coarse-grained soils are classified as follows: Less than 5 percent More than 12 percent 5 to 12 percent</div> <div>GW, GP, SW, SP GM, GC, SM, SC <i>Borderline cases requiring dual symbols^b</i></div>						<div>$C_u = D_{60}/D_{10}$ greater than 4; $C_c = (D_{30})^2/D_{10} \times D_{60}$ between 1 and 3</div> <div>Not meeting all gradation requirements for GW</div> <div>Atterberg limits below "A" line or P.I. less than 4</div> <div>Above "A" line with P.I. between 4 and 7 are <i>borderline</i> cases requiring the use of dual symbols</div> <div>Atterberg Limits below "A" line with P.I. greater than 7</div> <div>$C_u = D_{60}/D_{10}$ greater than 6; $C_c = (D_{30})^2/D_{10} \times D_{60}$ between 1 and 3</div> <div>Not meeting all gradation requirements for SW</div> <div>Atterberg limits above "A" line or P.I. less than 4</div> <div>Limits plotting in hatched zone with P.I. between 4 and 7 are <i>borderline</i> cases requiring the use of dual symbols</div> <div>Atterberg limits above "A" line with P.I. greater than 7</div>			
<div>Fine Grained Soils (More than half of material is smaller than No. 200 sieve size)</div> <div>Silts and clays (Liquid limit less than 50)</div> <div>ML</div> <div>Inorganic silts and very fine sands, rock flour, silty or clayey fine sands, or clayey silts with slight plasticity</div> <div>CL</div> <div>Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays</div> <div>OL</div> <div>Organic silts and organic silty clays of low plasticity</div> <div>MH</div> <div>Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts</div> <div>CH</div> <div>Inorganic clays of high plasticity, fat clays</div> <div>OH</div> <div>Organic clays of medium to high plasticity, organic silts</div> <div>Pt</div> <div>Peat and other highly organic soils</div> <div><div>Plasticity Chart</div></div>									

^a Division of GM and SM groups into subdivisions of d and u are for roads and airfields only. Subdivision is based on Atterberg limits; suffix d used when L.L. is 28 or less and the P.I. is 6 or less; the suffix u is used when L.L. is greater than 28.

^b Borderline classifications, used for soils possessing the characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder.

REFERENCE NOTES FOR BORING LOGS

I. Drilling Sampling Symbols:

SS	Split Spoon Sampler	ST	Shelby Tube Sampler
RC	Rock Core, NX, BX, AX	PM	Pressuremeter
DC	Dutch Cone Penetrometer	RD	Rock Bit Drilling
BS	Bulk Sample of Cuttings	PA	Power Auger (no sample)
HAS	Hollow Stem Auger	WS	Wash Sample

II. Correlation of Penetration Resistances to Soil Properties:

Standard Penetration (Blows/Ft) refers to the blows per foot of a 140 lb. Hammer falling 30 inches on a 2-inch OD split spoon sampler, as specified in ASTM D-1586. The blow count is commonly referred to as the N value.

A. Non-Cohesive Soils (Silt, Sand, Gravel and Combinations)

<i>Density</i>		<i>Relative Properties</i>	
Under 3 blows/ft.	Very Loose	Adjective Form	36% to 49%
4 to 10 blows/ft.	Loose	With	21% to 35%
11 to 30 blows/ft.	Medium Dense	Some	11% to 20%
31 to 50 blows/ft.	Dense	Trace	1% to 10%
51 to 80 blows/ft.	Very Dense		
Over 80 blows/ft.	Extremely Dense		

Particle Size Identification

Boulders		8 inches or larger
Cobbles		3 to 8 inches
Gravel	Coarse	1 to 3 inches
	Medium	½ to 1 inch
	Fine	¼ to ½ inch
Sand	Coarse	2.00mm to ¼ inch (dia. of lead pencil)
	Medium	0.42 to 2.00mm (dia. of broom straw)
	Fine	0.074 to 0.42mm (dia. of human hair)
Silt and Clay		0.0 to 0.074mm (particles cannot be seen)

B. Cohesive Soils (Clay, Silt, and Combinations)

<i>Unconfined Comp. Strength</i>				
<i>Blows/Ft</i>	<i>Consistency</i>	<i>Q_p(tsf)</i>	<i>Degree of Plasticity</i>	<i>Plasticity Index</i>
Under 4	Very Soft	Under 0.25	None to Slight	0 - 4
4 to 5	Soft	0.25-0.49	Slight	5 - 7
6 to 10	Medium Stiff	0.50-0.99	Medium	8- 22
11 to 15	Stiff	1.00-1.99	High to Very High	Over 22
16 to 30	Very Stiff	2.00-3.00		
31 to 50	Hard	4.00-8.00		
Over 51	Very Hard	Over 8.00		

III. Water Level Measurement Symbols

WL	Water Level	BCR	Before Casing Removal
WS	While Sampling	ACR	After Casing Removal
WD	While Drilling	WCI	Wet Cave-In
		DCI	Dry Cave-In

The water levels are those water levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in a granular soil. In clay and plastic silts, the accurate determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally applied.



April 28, 2014

Mr. Andrew Potts, PE
CH2M HILL
1717 Arch Street, Suite 4400
Philadelphia, PA 19103

Re: **Final Report of Subsurface Exploration & Infiltration Testing Services**
Proposed City of Lancaster *Green* Infrastructure Projects
Site 115 – W. James Street near N. Water Street
City of Lancaster, Pennsylvania
ALW Project No. 11-520G

Dear Mr. Potts:

The ALW Group, LLC (ALW) is pleased to present this letter outlining our findings for the above project site. This report has been provided to assist the design team with project design and construction planning and provides subsurface exploration results, boring location diagrams, final infiltration rates as determined via field infiltration testing, and boring logs.

Overview of Project

The project site (referred to as the “W. James Street”) and focus of this investigation was Site 115, which is generally located along W. James Street east of its intersection with N. Mulberry street in the City of Lancaster, Pennsylvania. In general, the work performed for this task included the advancement of a total of five (5) soil borings and accompanying auger probes (for infiltration testing) and field infiltration testing. Refer to Figure 1, *Boring Location Plan* for the location of the project site and approximate boring locations.

Scope of Services

A total of five (5) soil borings were advanced at the above project site at pre-determined locations utilizing a special access track-mounted drilling rig, hollow-stem augers and split-spoon sampling equipment. Each boring was continuously sampled in an effort to characterize the subsurface conditions in that area of the site such as soil types, any limiting conditions (top of rock, water table) and infiltration capacity.

The soil borings were advanced to the pre-determined target depths of 10.0 feet below the ground surface (bgs) or auger refusal, whichever occurred first. Borings B-1 through B-5 each, were advanced to a termination depth of 10 feet bgs.

An infiltration test hole (auger probe) was prepared (drilled) adjacent to each soil boring and was used for the field infiltration testing. Based on the conditions encountered throughout the boring exploration program, auger probes and infiltration tests were conducted at five feet bgs.

Upon reaching the termination depth, each test hole was cleared of any loose material and a 5-inch diameter PVC pipe was set within the boring. After each pipe was set, the annular space around the bottom of the pipe was sealed with hydrated bentonite to ensure no leakage would occur during the test procedure. Approximately 1 to 2 inches of 3/8-inch gravel was also placed (inside) at the bottom of the pipe to prevent scour of the soils during testing procedure.

After each hole was properly prepared, test locations were filled with potable water to a minimum of 24 inches over the gravel. It should be noted, that each test hole was also pre-soaked in the same manner. Once each hole was filled and the testing procedure was initiated, water level readings were subsequently recorded at appropriate intervals to measure the rate of infiltration. Testing at each location was continued until the infiltration rate stabilized.

All borings and probes were backfilled and patched upon completion.

Mapped Geologic Conditions

Based on a review of the *Geologic Map of Pennsylvania* (1980) and the *Map 61-Atlas of Preliminary Geologic Quadrangle Maps of Pennsylvania* (1975), the site is situated within the Piedmont Physiographic Province and is underlain by the Conestoga Formation. The Conestoga Formation is described as micaceous limestone, phyllite, and alternating dolomite and limestone. Joints have an irregular pattern and are poorly formed, moderately abundant, widely spaced, and uneven regularity; many are open but some are filled with quartz and calcite. Generally, the formation is described as having good surface drainage and minor subsurface drainage including few sinkholes.

A review of the *Sinkholes and Karst-related Features of Lancaster County, PA*, for the project site area depicted the site has being underlain by the Conestoga Formation. No sinkholes or sink-related features have been historically mapped on the project site. The mapping depicted the closest sink-related features (closed or partially closed depressions) over one-half mile from the project site.

During our site reconnaissance performed concurrent with the subsurface exploration program, no surface evidence indicative of karst/karst-related features was observed.

According to the *Soil Survey of Lancaster County Pennsylvania* (1982), the project site is underlain by Urban Land (Uc) soils. Urban land/soils are classified as areas where 85 percent or more of the surface is covered by roads, railroads, sidewalks, parking areas, houses, factories and other structures.

Details of the subsurface materials encountered are presented on the *Drilling Logs* attached to this report. The subsurface soil conditions encountered in the soil test borings consisted of the following generalized strata in order of increasing depth.

Summary of Subsurface Conditions

Surface Materials:

Each of the borings was drilled within existing asphalt paving. Surface materials encountered at each borings generally consisted of 7 to 11 inches of asphalt underlain by about 13 to 16 inches of stone subbase.

Fill Materials:

Beneath the pavement and subbase layer, approximately 3.5 to 4 feet of apparent existing fill was encountered at boring locations B-1 through B-5. The existing fills were visually classified as sandy SILTS (ML) with varying amounts of clay, gravel and brick.

Natural Soils:

Natural soils were encountered beneath the existing fills at each of the boring locations performed. The natural soils encountered at boring locations were visually classified as sandy to clayey SILT (ML) with varying amounts of rock fragments.

Groundwater was not encountered within any of the borings at the time of this exploration.

Infiltration Test Results

Auger probes were advanced adjacent to borings B-1 through B-5 for infiltration testing purposes. The table below outlines the infiltration test depth associated with each boring location.

Corresponding Boring for Infiltration Probe Hole/Test	Termination Depth of Corresponding Boring (feet bgs)	Depth of Infiltration Test (feet bgs)
B-1	10.0	5.0
B-2	10.0	5.0
B-3	10.0	5.0
B-4	10.0	5.0
B-5	10.0	5.0

The infiltration test results are summarized in the table below:

Infiltration Test Location	Reading #1 (in)	Reading #2 (in)	Reading #3 (in)	Reading #4 (in)	Reading #5 (in)	Reading #6 (in)	Reading #7 (in)	Reading #8 (in)	Reading #9 (in)	Reading #10 (in)
B-1	2.5	1.75	1.6	1.0	0.9	0.95	0.95	0.75	0.7	0.7
B-2	2.0	1.3	1.3	1.2	1.2	0.95	0.7	0.7	0.6	0.6
B-3	1.0	1.4	1.0	0.65	0.8	0.75	0.7	0.5	0.5	0.5
B-4	1.75	0.75	1.0	0.75	0.65	0.6	0.55	0.45	0.5	0.45
B-5	5.1	2.2	3.5	1.75	1.35	1.75	1.4	1.3	1.25	1.25

It should be noted that the data collection (measured readings) from infiltration testing at the above locations were performed according to the following intervals:

- *Readings #1 through #10 were collected in 30 minute intervals with measurements terminated once a generally stabilized rate of drop was measured*

As shown in the above table, the stabilized infiltration rates at borings B-1 through B-5 were measured between 0.5 and 1.25 inches per hour. In general, no confining or limiting layers were encountered within the depths of the exploration. Although the subsurface conditions appear likely to provide for the necessary design infiltration capacities, the designer should proceed with caution. The existing fill materials may be highly variable over short distances with infiltration capacities changing abruptly with depth depending on composition and in-place density. Further, based on the spacing of the exploration points and the encountered conditions, it is recommended that consideration be given to observation of the subsurface conditions at the time of construction in order to verify that the conditions are consistent with those encountered during the exploration and the assumptions utilized for design of the system.

Closing

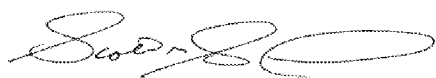
Surficial and subsurface information presented herein is based on field measurements obtained during the course of the exploration and site reconnaissance. The precision and accuracy of surficial data is a function of the references, benchmarks, methods and instruments employed, as summarized in the report. Subsurface data is based on measurements within the borehole using the sampling methods described on

the *Drilling Logs*. The completeness, precision, and accuracy of such data is a function of the frequency and type of exploration and sampling employed, as well as the precision and accuracy of the surface location and elevation of the borehole, and may vary from actual conditions encountered during excavations. Subsurface conditions between, beyond and below explorations, may vary dramatically from the nearest exploration, due to natural geologic action, deposition and weathering, or man-made activities.

We thank you again for this opportunity to provide our services on this project. Should you have any questions or require additional information, please contact us.

Very truly yours,

THE ALW GROUP, LLC

A handwritten signature in black ink, appearing to read 'Scott A. Summers', with a stylized, flowing script.

Scott A. Summers, PG
Managing Principal

Attachments: Boring Location Plan (1)
Boring (Drilling) Logs (5)



DRILLING LOG

Project Name:		SITE 115 - W James Street				BORING ID:		B-1	
Project #		11-520G				Total Depth:		10.0'	
Location:		N. Mulberry Street, City of Lancaster, PA				Surface Elev.:			
Date Drilled:		3/25/2014				Sampling Method:		HSA/ 3.25" SS	
Driller/Drill Equip.:		SSE, LLC / Acker Soil Scout				Monitoring Device:			
Static Water Level:		Groundwater not encountered				Logged by:		D. Kaminski	

Depth Below Surface (Feet)	Blow Count	Recovery	Sample Interval	Sample ID#	Lithologic Description	USCS Classification	PID Results	Depth Below Surface (Feet)
			0-2.0		11" of Asphalt over 13" of Stone Subbase			
2.0	1-1-1-3	11	2.0-4.0	B-1 (S-1)	Brown sandy SILT with gravel, traces of clay and asphalt fragments, very soft, moist	FILL		2.0
4.0	5-4-3-4	15	4.0-6.0	B-1 (S-2)	Brown to Grey sandy to clayey SILT, soft to stiff, moist	ML		4.0
6.0	2-5-5-6	20	6.0-8.0	B-1 (S-3)				6.0
8.0	6-6-7-8	16	8.0-10.0	B-1 (S-4)				8.0
10.0					END OF BORING @ 10.0 FT			10.0
12.0								12.0
14.0								14.0
16.0								16.0
18.0								18.0
20.0								20.0



DRILLING LOG

Project Name:		SITE 115 - W James Street				BORING ID:		B-2	
Project #		11-520G				Total Depth:		10.0'	
Location:		N. Mulberry Street, City of Lancaster, PA				Surface Elev.:			
Date Drilled:		3/25/2014				Sampling Method:		HSA/ 3.25" SS	
Driller/Drill Equip.:		SSE, LLC / Acker Soil Scout				Monitoring Device:			
Static Water Level:		Groundwater not encountered				Logged by:		D. Kaminski	

Depth Below Surface (Feet)	Blow Count	Recovery	Sample Interval	Sample ID#	Lithologic Description	USCS Classification	PID Results	Depth Below Surface (Feet)
			0-2.0		10" of Asphalt over 14" of Stone Subbase			
2.0	1-1-3-3	13	2.0-4.0	B-1 (S-1)	Brown sandy SILT with gravel, traces of clay and asphalt fragments, very soft, moist	FILL		2.0
4.0	3-4-5-6	18	4.0-6.0	B-1 (S-2)	Brown to Grey sandy to clayey SILT, soft to stiff, moist	ML		4.0
6.0	5-6-6-8	14	6.0-8.0	B-1 (S-3)				6.0
8.0	5-6-8-8	24	8.0-10.0	B-1 (S-4)				8.0
10.0					END OF BORING @ 10.0 FT			10.0
12.0								12.0
14.0								14.0
16.0								16.0
18.0								18.0
20.0								20.0



DRILLING LOG

Project Name:		SITE 115 - W James Street				BORING ID:		B-3	
Project #		11-520G				Total Depth:		10.0'	
Location:		N. Mulberry Street, City of Lancaster, PA				Surface Elev.:			
Date Drilled:		3/26/2014				Sampling Method:		HSA/ 3.25" SS	
Driller/Drill Equip.:		SSE, LLC / Acker Soil Scout				Monitoring Device:			
Static Water Level:		Groundwater not encountered				Logged by:		D. Kaminski	

Depth Below Surface (Feet)	Blow Count	Recovery	Sample Interval	Sample ID#	Lithologic Description	USCS Classification	PID Results	Depth Below Surface (Feet)
			0-2.0		7" of Asphalt over 16" of Stone Subbase			
2.0	1-2-1-1	13	2.0-4.0	B-1 (S-1)	Brown sandy SILT with gravel, traces of clay and asphalt fragments, very soft, moist	FILL		2.0
4.0	6-7-2-5	18	4.0-6.0	B-1 (S-2)	Brown to Grey sandy to clayey SILT, soft to stiff, moist	ML		4.0
6.0	5-6-7-10	21	6.0-8.0	B-1 (S-3)				6.0
8.0	6-6-8-9	22	8.0-10.0	B-1 (S-4)				8.0
10.0					END OF BORING @ 10.0 FT			10.0
12.0								12.0
14.0								14.0
16.0								16.0
18.0								18.0
20.0								20.0



DRILLING LOG

Project Name:		SITE 115 - W James Street				BORING ID:		B-4	
Project #		11-520G				Total Depth:		10.0'	
Location:		N. Mulberry Street, City of Lancaster, PA				Surface Elev.:			
Date Drilled:		3/26/2014				Sampling Method:		HSA/ 3.25" SS	
Driller/Drill Equip.:		SSE, LLC / Acker Soil Scout				Monitoring Device:			
Static Water Level:		Groundwater not encountered				Logged by:		D. Kaminski	

Depth Below Surface (Feet)	Blow Count	Recovery	Sample Interval	Sample ID#	Lithologic Description	USCS Classification	PID Results	Depth Below Surface (Feet)
			0-2.0		7" of Asphalt over 16" of Stone Subbase			
2.0	2-3-2-2	12	2.0-4.0	B-1 (S-1)	Brown sandy SILT with gravel, traces of clay and asphalt fragments, very soft, moist	FILL		2.0
4.0	8-8-9-12	12	4.0-6.0	B-1 (S-2)	Brown to Grey sandy to clayey SILT, medium stiff to stiff, moist	ML		4.0
6.0	8-11-18-11	19	6.0-8.0	B-1 (S-3)				6.0
8.0	13-14-14-15	22	8.0-10.0	B-1 (S-4)				8.0
10.0					END OF BORING @ 10.0 FT			10.0
12.0								12.0
14.0								14.0
16.0								16.0
18.0								18.0
20.0								20.0



DRILLING LOG

Project Name:	SITE 115 - W James Street	BORING ID:	B-5
Project #	11-520G	Total Depth:	10.0'
Location:	N. Mulberry Street, City of Lancaster, PA	Surface Elev.:	
Date Drilled:	3/26/2014	Sampling Method:	HSA/ 3.25" SS
Driller/Drill Equip.:	SSE, LLC / Acker Soil Scout	Monitoring Device:	
Static Water Level:	Groundwater not encountered	Logged by:	D. Kaminski

Depth Below Surface (Feet)	Blow Count	Recovery	Sample Interval	Sample ID#	Lithologic Description	USCS Classification	PID Results	Depth Below Surface (Feet)
			0-2.0		8" of Asphalt over 16" of Stone Subbase			
2.0	2-3-2-4	18	2.0-4.0	B-1 (S-1)	Brown sandy SILT with gravel, traces of clay and asphalt fragments, very soft, moist	FILL		2.0
4.0	4-10-14-15	22	4.0-6.0	B-1 (S-2)	Brown to Tan sandy to clayey SILT, varying amounts of rock fragments, medium stiff to stiff, moist	ML		4.0
6.0	5-6-7-8	22	6.0-8.0	B-1 (S-3)				6.0
8.0	8-8-11-16	23	8.0-10.0	B-1 (S-4)				8.0
10.0					END OF BORING @ 10.0 FT			10.0
12.0								12.0
14.0								14.0
16.0								16.0
18.0								18.0
20.0								20.0



Reference: Google Earth; For Conceptual Purposes
Approximate Scale: 1" = 50'±



Site 115
W. James Street
City of Lancaster, PA



FIGURE 3
Boring Location Diagram
ALW Project No.: 11-520G
April 2014